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Use of Mouthguards and Headgear in Organized Sports by School-aged Children

SYNOPSIS

SPORTS-RELATED OROFACIAL trauma is a serious problem that can be prevented by wearing protective mouthguards and headgear. While this equipment is available, few studies have been done of wearing practices. This study assesses the wearing practices using data from the Child Health Supplement of the 1991 National Health Interview Survey. Results indicate that football was the only sport in which the majority of children used mouthguards and headgear. While statistically significant differences ($p \leq .05$) were found in use of the equipment in all sports by grade level, gender, parent's education, ethnicity, and by region of the country, these differences were not consistent across sports. Healthy People 2000 calls for extending requirements for use of orofacial protective devices to all organizations sponsoring sports that pose risk to injury. Given the complex nature of the findings, multifaceted initiatives that include the promulgation of rules must be developed and tested to determine what approaches are effective in ensuring consistent use.

Injuries are a leading cause of morbidity and mortality in children and youth in the United States¹. Of growing concern are injuries that occur during participation in organized sports². One type of injury, orofacial trauma, can result in broken and avulsed teeth, facial bone fractures, concussion, permanent brain injury, TMJ dysfunction, blinding eye injuries, and even death^{3,4}. The concern about orofacial injury is addressed in a Healthy People 2000 Objective that calls for extending requirements for the use of orofacial protective devices to all organizations, agencies, and institutions sponsoring sporting and recreation events that pose risks of injury¹.

While no systematic monitoring for orofacial injuries exists, it is estimated that as many as one-third of all dental injuries are sports-related^{5,6}. A particularly high prevalence of all baseball injuries, 41%, occur to the head, face, mouth, or eyes⁷. Prior to the institution of rules by the National Alliance Football Rules Committee in 1962 that required the use of orofacial protective devices for high school football players, an estimated 50% of all football injuries were to the mouth and face. Current estimates are that 1.4% of football injuries are to orofacial regions⁸. Similarly, data from the mid-1970s indicate that 45% of hockey injuries in children ages 10 to 16 occurred above the

shoulders, with 13% being dental injuries. Following the establishment of standards specifying the use of head and face guards in hockey by combined associations and federations in 1977 and the subsequent requirements in the rules for amateur leagues as well as collegiate and high school competition, injury rates dropped dramatically⁹.

Equipment that prevents orofacial injuries and concussion has been available for decades, yet little is known about the extent to which it is used. This study aimed to estimate current participation of school age children in organized sports and assess their use of protective headgear and mouthguards. These national data will provide baseline information for the development and evaluation of targeted strategies designed to reduce the occurrence of sports-related injuries in children.

Methods

We analyzed household survey data obtained for the 1991 National Health Interview Survey (NHIS) of Child Health focusing on responses given by the 9,630 interviewed parents (or guardians) of children ages 7 through 17. The National Center for Health Statistics (NCHS) followed established NHIS standards for sampling of participants, conduct of interviews, and data quality control procedures¹⁰.

In the 1991 survey, parents were asked whether the sampled child had played any of the listed organized sports (football, baseball or softball, soccer, field or ice hockey, wrestling, lacrosse, rugby, boxing, karate or judo) during the previous twelve months and, if yes, how frequently the child wore protective headgear or a mouthguard. For the present study, we looked at selected demographic and socioeconomic variables as follows: geographic region of residence, gender, school grade level (elementary, grades 1 through 5; middle, grades 6 through 8; high school, grades 9 through 12), "race" (black, white), "ethnicity" (Hispanic, non-Hispanic), education of parent (high school or less, more than high school), poverty status (below, at/above Federal poverty level). "Race" and "ethnicity" were defined by the respondent's self-perception and are separate variables, for example, a child could be both black and Hispanic.

Statistical Analysis. For our analyses, sampling weights were used in order to generalize to the 1991 non-institutionalized U.S. child population aged 7 to 17 years. SUDAAN statistical software, which was created for use with complex, multistage sample designs, was used to calculate standard errors for estimates. All comparisons that are

reported as statistically significant are at $p \leq .05$ after accounting for multiple comparisons. Log linear chi-square was used to test for independence, p-values are based on the F-statistic using the Wald chi-square with denominator degrees of freedom equal to the number of Primary Sampling Units (PSU) minus the number of strata.

Results

Who Is at Risk for Orofacial Injury? In 1991, over 14 million school-aged children in the United States participated

in at least one of the listed sports, with over one-fourth of this group involved in two or more sports. (See table 1 for estimated population of children playing each sport.) Males played an organized sport more than females (23% females played, 54% male played). Playing an organized sport varied by region of the country: in the south 33% played, compared to 43% in the Northeast, 43% in the Northwest, and 41% in the West. Playing an organized sport varied by socioeconomic status: 28% of

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children below poverty played while 43% at or above poverty played; 33% of children whose parent had less than high school education played in contrast to 45% of those whose parent had more than high school). White children (42%) were more likely to play organized sports than black children (27%). Also, non-Hispanic children (40%) more often played organized sports than Hispanic children (34%).

Baseball or Softball. Baseball and softball were the most popular organized children's sports, with an estimated 24% of the school-aged population playing one or both (table 1).

While headgear and faceguards have been developed for

Table 1. Estimated totals and percentages of children who played organized sports in the United States, 1991.

Sport	Number	Percent
Baseball/Softball	9,338,980	24.4
Soccer	4,906,134	12.8
Football	3,824,708	10.0
Karate/Judo	977,180	2.6
Wrestling	960,763	2.5
Field/Ice Hockey	603,008	1.6
LaCrosse	141,480	.4
Boxing	144,380	.4
Rugby	52,686	.1

Table 2. Percentages of children who wear headgear and mouthguards while playing baseball or football by selected variables.

	Baseball		Football	
	Headgear	Mouthguard	Headgear	Mouthguard
Total	35	7	72	72
Gender:				
Male.....	40	8	77	77
Female.....	25	5	15	15
Grade level:				
Elementary.....	35	6	52	52
Middle.....	36	9	80	79
High School.....	35	12	88	88
Race:				
Black	33	17	74	71
White.....	35	6	72	72
Ethnicity:				
Hispanic.....	33	11	46	52
non-Hispanic.....	36	7	77	75
Poverty level:				
Below.....	24	11	54	54
At/Above.....	36	6	77	75
Parent's education:				
<HS/HS.....	34	8	68	69
>HS.....	36	6	78	75

baseball and softball players, not all leagues or teams require use of safety equipment; in many cases, only selected positions such as catchers and batters are covered by the rules. Our analyses substantiate this pattern of rules. In 1991, among those who played baseball or softball, only 35% wore headgear all or most of the time, and only 7% wore mouthguards all or most of the time. Differences existed in the use of headgear during baseball and softball by gender, with a greater percentage of males (40%) wearing the device than females (25%), and by poverty level, with 36% of those at or above poverty wearing headgear compared with 24% of those below poverty level.

A greater proportion of high school children (12%) than elementary school children (6%) wore mouthguards. Also, more black (17%) than white (6%) children wore mouthguards (table 2). No differences were found for gender, and the cell sizes were too small to permit interpretation of the data by other sociodemographic variables.

Since the aforementioned standards for baseball encourage batters' helmets and catchers' masks, there is more pos-

sibility that parents would have responded "some of the time" to the headgear questions. To assess this, the responses to the 1991 questions on baseball or softball headgear were analyzed by always (35%), sometimes (43%) and never (22%). The same differences as reported above are observed for gender and race. In addition, white children were reported as "sometimes" using headgear more often than blacks (46% vs. 19%); children whose parents were better educated were more likely to have occasional use of headgear than ones with less-educated parents (45% vs. 38%); and non-Hispanics had occasional use more than Hispanics (43% vs. 30%). Lower socioeconomic children (using any of the SES indicators) and girls were more likely never to use headgear in baseball or softball.

Soccer. Soccer was the second most popular sport among school-aged children in 1991 (table 1). As might be expected given the absence of US Soccer Federation rules for protection from orofacial injury and no mention of such devices in texts for coaches and athletes, our analyses found that only 4% of soccer players wore headgear and 7% wore mouthguards. The use of headgear did not vary by grade level; however, the use of mouthguards among high school students (14%) was greater than among elementary school children (4%). Cell sizes were not sufficient for interpretation of other demographic or socioeconomic factors.

Football. Ten percent of U.S. school-aged children played organized football in 1991 (table 1). While rules mandating the use of headgear and mouthguards have existed for over three decades, our analysis indicated that only 72% of children who played football wore headgear and mouthguards all or most of the time (table 2). Statistically significant differences existed in the use of headgear by gender (77% males, 15% females), grade level (88% high school, 52% elementary), ethnicity (77% non-Hispanics, 46% Hispanics), poverty level (77% at or above, 54% below), and parental education (78% more than high school, 68% high school or less).

We found statistically significant differences in the use of mouthguards by gender (77% males, 15% females), grade level (88% high school, 52% grade school), ethnicity (75% non-Hispanic, 52% Hispanic), and poverty level (75% at or above poverty, 54% below poverty).

Other Organized Sports. Overall population estimates for child or youth participation in wrestling, karate/judo, field/ice hockey, lacrosse, rugby, and boxing are presented in table 1. Due to insufficient cell size, the use of orofacial devices cannot be analyzed by sociodemographic variables.

Discussion

Differences exist in use of headgear and mouthguards but are not consistent across all sports. Considerably more information is needed on injuries in youth sports and the use of headgear and mouthguards.

The actual risk to injury in childhood sporting activities may be greater than is represented here since only selected organized sports were included in this survey, e.g. organized basketball and less official forms of other sports were not listed. Other methodological artifacts potentially affecting the responses included the lack of distinction among types of sports, e.g., contact, tag, or flag football, and the dependence on parent's knowledge of a child's behaviors.

Rules and regulations. Healthy People 2000 calls for the development of rules and regulations by all sponsors of organized sports that pose a risk of injury. The data reported suggest that such regulations are positive health promotion strategies: football, with rules, had the greatest use of equipment. The moderate use of headgear among baseball and softball players appears to be related to rules that require use for selected players. In contrast, the very low use of safety equipment in soccer may be associated with an absence of regulations on their use. Barriers to development and acceptance of rules appear to include lack of awareness of the potential for injury, inappropriate or unavailable equipment, and expense. Unlike other countries, the United States has no overarching authority to require the use of orofacial protective devices by players or for the appropriate education of youth sports officials. The efforts of advocacy groups are thwarted by the fragmented nature of youth sports in the United States¹.

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Behavior change. Parental perceptions of children's risks to injury, expenses associated with protective gear, and peer pressure may influence use of mouthguards and headgear. Interestingly, lower socioeconomic parents are reported to be more aware of threats to their children's safety than are affluent parents¹⁵. One of the major sources of harassment among children is orofacial features¹⁶, thus, comments by peers or the anticipation of comments about devices may be sufficient to deter gear usage.

The observed wearing patterns of males and females may represent perceptual and cultural differences, peer pressure, and/or the nature of sports played: 1) Perceptions that females are less aggressive and thus at reduced risk of injury may exist. 2) Perceptions regarding the absence of long-term commitment to a sport may result in a differential willingness to devote resources to females. 3)

Aesthetic appeal may differentially influence protective orofacial gear usage. 4) Females may play in non-league-based sports with fewer or less stringent rules or may play less combative sports than males. Since injury rates for females playing specific sports are similar to those for males¹⁷⁻¹⁹, the differential use of protection must be changed.

Product design. Problems associated with protective mouthguards include speech impairment, discomfort, limited durability and poor fit²⁰. However, custom-made mouthguards, while more costly and time consuming to have made by a dentist, reduce such complaints and provide the best protection from injury²⁰⁻²². In a study of high school Lacrosse players, both male and female preferred custom-made mouthguards, however, males reported that they would wear the less comfortable "boil and bite" mouthguards to avoid multiple dental office appointments. Few females actually wore either the standard or custom mouthguards²¹.

While sports officials and dentists are encouraged by professional organizations and others to initiate mouthguard programs^{5,23,18}, a review of the literature indicates that few programs exist²⁰. Innovative strategies must be developed to increase the use of custom-made mouthguards which are effective, readily available, and affordable for children of all ages. Since mouthguards must adapt to the rapidly changing dentition and to orthodontic

appliances, numerous challenges exist in bioengineering, health professional consultation and marketing.

Health education and health promotion campaigns. In our study, high school athletes wore orofacial protection more than elementary-aged children. The differences in use could be in part attributed to resources, regulations, and perception of commitment to the sport in school versus community programs.

Some high schools have the advantage of formally educated coaches, certified athletic trainers and team physicians to develop sports safety programs. Yet, an estimated 80% of all those who coach organized sports in the U.S. have never taken classes designed to enhance their knowledge of the sport they are coaching²⁴ or the basics of injury prevention and emergency procedures¹. Several organizations have developed educational materials and training sessions for coaches^{1,14,24} but the use of these is discretionary.

The literature indicates that behaviors of athletes are most influenced by coaches²⁵. Coaches report that most information about mouthguards comes from sales representatives (72%), educational materials (33%), and dentists (11%)²¹. Targeted education and health promotion could be directed toward each of these groups, as well as the general public, parents and athletes themselves.

Unfortunately, some youth sports organizers are refusing to participate in educational programs because they believe that they can be held liable for injuries only after receiving education. Recent legal suits have determined that coaches can indeed be held liable with or without formal education²⁶. One national organization, in response to growing concerns about volunteers, provides liability insurance as an incentive to coaches who complete a three-year certification program which includes first aid and safety training²⁴.

In conclusion, it appears that a set of complex issues surround the use of orofacial protective devices for youth sports in the United States. Under the umbrella of Healthy People 2000, the public health sector, working with the private sector, must strengthen programs, program guidelines, methods for dissemination of information about successful approaches and surveillance systems. Clearly, if orofacial injuries are to be prevented in sports, demonstration research projects and innovative programs using multifaceted approaches at all levels, across many sports, and in many environments must be tested and, if effective, implemented.

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References

1. Healthy People 2000: national health promotion and disease prevention objectives. Washington DC: Government Printing Office; 1991 DHHS pub.no.(PHS)91-50212.
2. Micheli, LJ. Sportwise: an essential guide for young athletes, parents, and coaches. Boston MA: Houghton Mifflin, 1990.
3. Chapman, PJ. Concussion in contact sports and importance of mouthguards in protection. *Aust J of Sci Med Sport* 1985;17:23-27.
4. Gurdjian ES, Lissner HR, Evans FG, et al. Intracranial pressure and acceleration accompanying head impacts in human cadavers. *Surg Gynecol Obstet* 1961;113:185-190.
5. Lephart SM, Fu FH. Emergency treatment of athletic injuries. *Dent Clin North Am* 1991;35:707-17.
6. Meadow, D., Lindner, G., and Needleman, H.: Oral trauma in children. *Ped Dent* 1984;6:248-251.
7. US Consumer Product Safety Commission: Overview of sports related injuries to persons 5-14 years of age. Washington DC: US Consumer Product Safety Commission, 1981.
8. Sane J. Comparison of maxillofacial and dental injuries in four contact team sports: American football, bandy, basketball and handball. *Am J Sports Med* 1988;16:47-51.
9. Castaldi CR. Eye, face and head protection in sports. *Association News* 1985;4:52-55.
10. National Center for Health Statistics (NCHS): Public use file documentation, National Health Interview Survey of Child Health, 1991. Hyattsville MD: National Center for Health Statistics 1992.
11. Christophersen ER. Improving compliance in childhood injury control. In Krasnegor NA, Epstein L, Johnson SB, Yaffe SJ (eds). *Developmental Aspects of Health Compliance Behaviors*. Hillsdale NJ: Lawrence Erlbaum, 1993, pp. 219-231.
12. The National Committee for Injury Prevention and Control: Introduction: a history of injury prevention. *Am J Prev Med* 1989; 5:4-18.
13. Perry CL, Barnowski T, Parcel GS. How individuals, environments, and health behaviors interact: social learning theory. In: K. Glanz, F.M. Lewis, B. K. Rimer eds. *Health behavior and education*. San Francisco CA: Jossey-Bass Publisher 1990;161-186.
14. American Sports Education Program: Successful coaching. Champaign IL: Human Kinetics 1990;1-237.
15. Glik D, Kronenfeld J, Jackson K. Predictors of risk perceptions of childhood injury among parents of preschoolers. *Health Educ Q* 1991;18:285-301.
16. Shaw WC, Addy M, Ray C. Dental and social effects of malocclusion and effectiveness of orthodontic treatment: a review. *Comm Dent Oral Epidemiol* 1980;8:36-45.
17. Chanby T, Grana W. Secondary school athletic injury in boys and girls: a three year comparison. *Phys Sports Med* 1985;13:106-111.
18. Morrow RM, Kuebker WA. Sports dentistry: a new role. *Dent School Qu UTHSC at San Antonio* 1986;2:10-13.
19. Hodge-Williams V. Testimony presented March 16, 1994. *Head Stand* 1994;12:3-4,17.
20. Seals RR, Morrow RM, Kuebker WA, et al. An evaluation of mouth-guard programs in Texas high school football. *J Am Dent Assoc* 1985;110:904-909.
21. DeYoung A, Godwin W, Robinson E. Comparison of comfort and wearability factors of boil-and-bite and custom mouthguards. Abstract 1390. *J Dent Res* 1993;72:277.
22. Kerr IL. Mouthguards for the prevention of injuries in contact sports. *Sports Med* 1986;3:415-427.
23. American Dental Association, Bureau of Health Education and Audiovisual Services and Council on Dental Materials, Instruments and Equipment: Mouth protectors and sports team dentists. *J Am Dent Assoc* 1984;109:84-87.
24. Kimiecik JC. Who needs coaches' education? US coaches do. *Phys Sports Med* 1988;16:124-136.
25. Ranalli DN, Lancaster DM. Attitudes of college football officials regarding NCAA mouthguard regulations and player compliance. *J Public Health Dent* 1993;53:96-100.
26. Adams S. Sports and the courts: action moves from field to courtroom; coaches have defined legal duties. *Interscholastic Athletic Administration* 1990;17:6-9.